

20 AMP POWER SUPPLY

... with overvoltage and overcurrent protection

Moorabbin and District Radio Club
PO Box 88, East Bentleigh, Vic. 3165

A power supply which incorporates fixed overcurrent limiting and short circuit protection.

FOR NEARLY 20 YEARS the Moorabbin and District Radio Club (MDRC) has, from time to time, published articles to help with kits for these supplies.

To date, three "Marks" have been introduced. In every case a redesign has been necessary only to overcome supply problems — usually when a specific component has gone off the market.

The Mark 3, first introduced some three years ago, used a 78HG primary regulator. These are now no longer available and a redesign to overcome this problem has led to the "Mark 4" which is described in this article.

Whilst overvoltage protection has always been a feature of these supplies, it was decided that the new "Mark" would also incorporate fixed overcurrent limiting and thus short circuit protection. Finally, it was decided to include protection against mains borne "spikes" which can lead to the unwanted operation of the overvoltage trip facility.

The voltage output is variable between eight and 15 volts.

Figure 1 gives the circuit diagram whilst Figure 2 gives the layout of the components (enclosed within the dotted lines on Figure 1) on the 153 millimetres by 153 millimetres circuit board.

Input from 220/240 volts AC mains is fused and switched in the normal way. Across the input to the transformer is a 275 volts AC varistor. This device has a very high resistance until the voltage across it rises above 275 volts AC. It then rapidly becomes a short circuit and thus clips any high voltage spikes. The component used is a GEC V275LA20A, or equivalent. It is rated to withstand a short circuit current of 4500 amps for periods of up to 20 microseconds.

The transformer is designed to Club specifications and has a very generous continuous duty secondary rating of 20 amps. The secondary AC output is rectified by a 35 amp bridge rectifier and smoothed by 33600 mfd of capacity (six 5600 mfd 40 volt high ripple current capacitors in parallel). Since the rectifier generates some 30 watts of heat, it is essential that it be mounted on a good heat sink. A 75 millimetre length of *Minifin* is recommended.

A 200 ohm 20 watt resistor, consisting of two 100 ohm 5 watt units, is paralled across the

capacitor output as a safety measure. It ensures that the large (and dangerous) charge in the capacitors is quickly bled off when the power supply is switched off. (It is recommended that these five watt resistors and also those in the 2N3055 emitters be mounted on standoff spacers to reduce the heat they could apply to the circuit board. —Tech Ed.)

The smoothed DC then goes through a heavy duty relay whose contacts are in the closed position if the relay coil is unenergised. When and if the coil is energised, these contacts open, DC to the rest of the supply is cut off, and an overvoltage indicator LED lights up.

The primary regulator is a 723 14 pin DIL device. It has been around for a long time and is an industry standard, consequently, its long term availability is assured.

The circuit configuration of the 723 is quite conventional and is taken straight from the maker application data except that some additional 1n0 ceramic capacitors have been strategically placed around it to prevent RF interference and subsequent malfunction in strong RF fields.

The output of the 723, whose level is set by an on board 1k0 trimpot, drives the base of a single 2N3055 which, in turn, drives the bases of eight paralleled 2N3055 pass transistors. The 2k2 resistor (between the base of the driver 2N3055 and earth) assists stability and the 1.0 mfd 100 volt *Greencap* across it provides some additional mid-frequency smoothing.

The use of eight 2N3055 pass transistors is quite deliberate. It is true that a 2N3055 can pass 10 amps but, at this current level, the DC gain has dropped to an alarmingly low level and little or no regulating capability remains. Assuming that the 2N3055 is at the lowest end of its DC gain specification then each pass transistor should carry no more than 2.5 amps if the capabilities of the driver transistor and the 723 are not to be overtaxed.

Like the rectifier, these pass transistors **must** be mounted on adequate heat-sinks and it is recommended that four 150 millimetre lengths of *Minifin* be used, with two transistors on each piece.

Each of the eight pass transistors has a 0.22 ohm five watt "current sharing" resistor in its emitter. The other ends of these eight resistors are joined and go to the output terminal through three paralleled 0.1 ohm five watt resistors. These three resistors have an effective resistance of $0.1/3 = 0.033$ ohms. At 20 amps drain or greater, the voltage drop across this 0.033 ohms exceeds 0.67 volts and is applied across pins two

and three of the 723, whose internal circuitry then progressively reduces its voltage output, and thus the voltage and current drawn by the external load.

The overvoltage protection acts as follows: For outputs of up to 15 volts, the Zener diode does not conduct. Above 15 volts it does conduct and a voltage appears across the 470 ohm resistor between the zener and earth. This voltage is filtered and applied to the BD139/BD140 combination which causes them to draw current through the relay coil. This breaks the DC supply to the regulating section and energises the overvoltage indicator LED. The supply will remain in the cut off condition until AC is removed from the transformer primary and the capacitors discharged through the 200 ohm 10 watt resistor across them.

Optional voltage and current monitoring can be obtained by means of a 0 to 30 amp meter in series between the output from the PCB and the front panel positive terminal, while voltage can be measured by a 0 to 20 volt meter across the output terminals.

It will be noticed that the supply is "floating", ie the supply is **not** connected to the mains earth. The mains earth is connected only to the electrostatic shield of the transformer and to the metalwork of the case used. It is recommended that this mains/shield/case earth lead be brought to a separate front panel terminal for connection to the negative supply output terminal if required. The PCB corner mounting holes are not connected to any "earthy" tracks on the board itself.

Normally the voltage setting potentiometer is on the control board and is set to give one, and only one, output voltage. However, if required, this pot can be omitted and replaced with a 1k0 *linear* standard pot which can be mounted on the front panel. This will enable the output voltage to be varied as required between a low of eight volts and the upper limit of 15 volts determined by the overvoltage circuitry.

Connections shown in Figure 1 by the thick black lines should be in wire capable of handling at least 20, but preferably 30 amps.

The supply can be "packaged" to suit individual requirements although it is strongly recommended that some sort of enclosed case/cabinet be used for safety reasons.

Anyone wishing to construct this supply can obtain further information and advice, by writing to:

The Project Officer, Moorabbin and District Radio Club, PO Box 88, East Bentleigh, Vic. 3165.

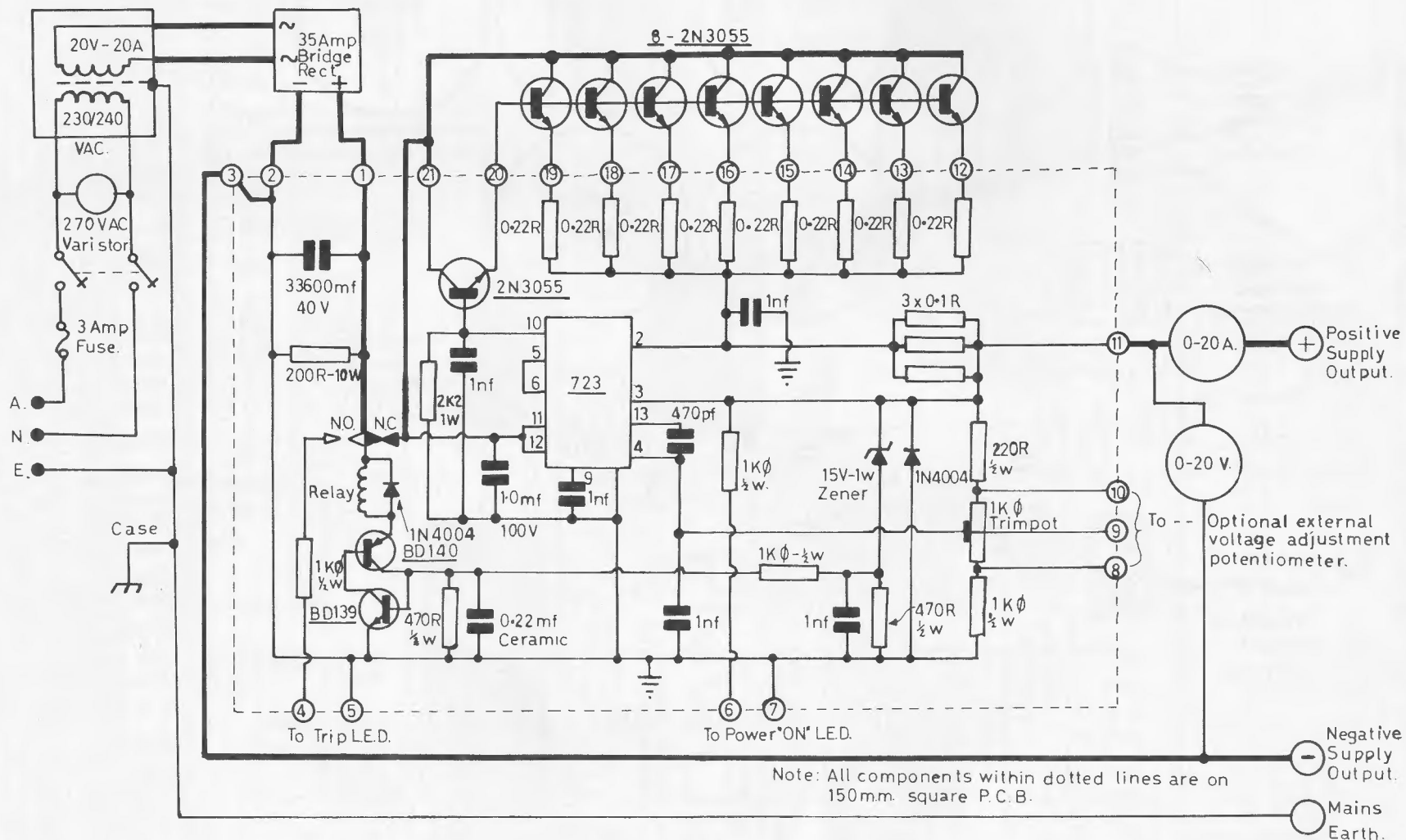


Figure 1: Mark IV 20 Amp Power Supply.

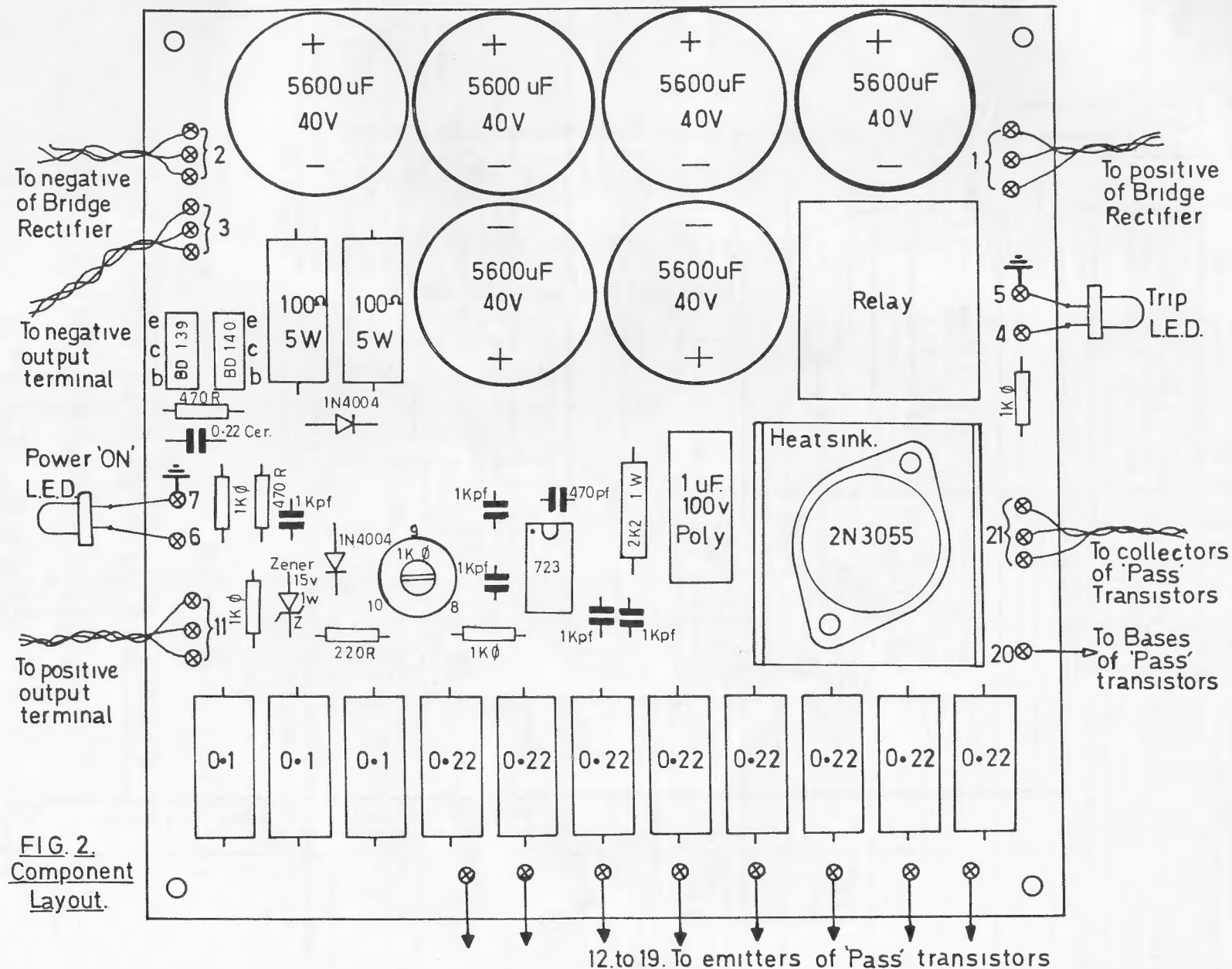


FIG. 2.
Component
Layout.

Figure 2: Component Layout.